بسم الله الرحمن الرحيم

PLC Course

مقرر الحاكمات المنطقية البرمجة

Lec 7

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PLC Counters

PLC Counters

- PLC counters are similar to timers except that they do not operate on an internal clock but are dependent on external or program sources for counting.
- The normal counters are typically “software” counters – they don’t physically exist (they are internals) in the PLC and they are simulated in software.
- A counter is set to some preset value (PR) determined by the programmer, and when this value of input pulses has been received (it counts the required counting preset value), it changes its contacts position from normal state to new state.

PLC Counters

- Unlike timers, which stop timing when Accumulated time = Preset Time , a counter will continue counting up or down (the accumulator will still counting up or down even if it counts the required preset value).
- Counters are normally retentive as it retains the accumulated (AC) value when an off/on power cycle occurs.
- To reset the accumulated value of the counter (AC), use a reset instruction (RES) in another rung with the same address as the counter.

PLC Counters

- Most manufacturers consider the counter as a relay and consist of :

1) One relay coil to count (up or down) input pulses
2) One relay coil to reset the counter
3) The associated contacts of the counter being used in other rungs.

Common Applications Using PLC Counters

1) **Bottle filling and packaging** , counter is used to count number of bottles filled in a particular batch.
2) **parking garage**, counter is used to count the number of cars that entered and leave the garage.
3) **Production line**, counter is used to provide continuous monitoring of the number of processed items in any part of the production line.

The Counter Parameters

- There are two main parameters used counter :

(1) Preset Counter Value (PR):

- It specifies the value which will be counted by the accumulator.
- It should be an integer value.
- It should be determined by the programmer/user.

(2) Accumulated Counter Value (AC):

- It indicates the counting process that is done by the counter.
- Its value is changed by 1 (increment or decrement) when **false-to-true** (**off-to-on** OR **open-to-close**) rung transitions occurs.

Counter Types

- There are three types of counters:

1) Up-counter (CTU)
2) Down-counter (CTD)
3) Up-down counter

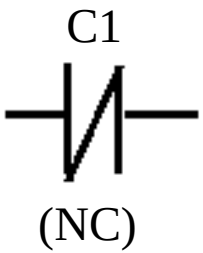
(1) Up-counter (CTU)

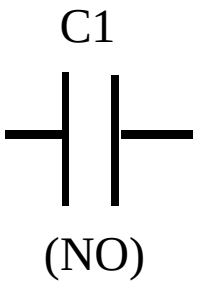
- UP-Counter increases the accumulated value by 1 at each false-to-true transition occurs.
- AC is initialized by zero (start counting from zero) and then it increments at each false-to-true transition.
- The AC value may be exceeds the PR value according to the no. of false-to-true transition.
- CTU is energized and changes the position of its contacts (from normal state to a another state) when AC value equals the PR value and still energized even if the AC value exceeds the PR value (CTU is energized while AC ≥ PR).

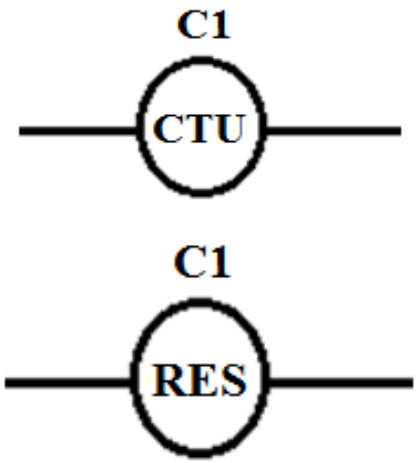
(1) Up-counter (CTU)

- When we reset the CTU by the RES instruction, the AC value is reset to zero and the CTU is de-energized.

- Symbols used in ladder diagram:

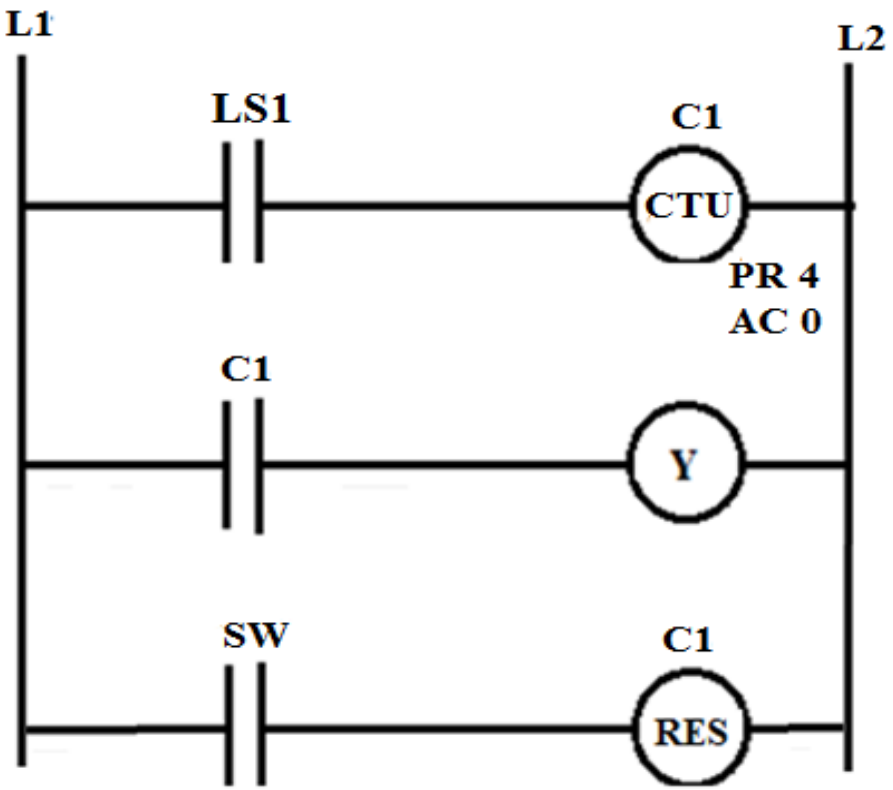




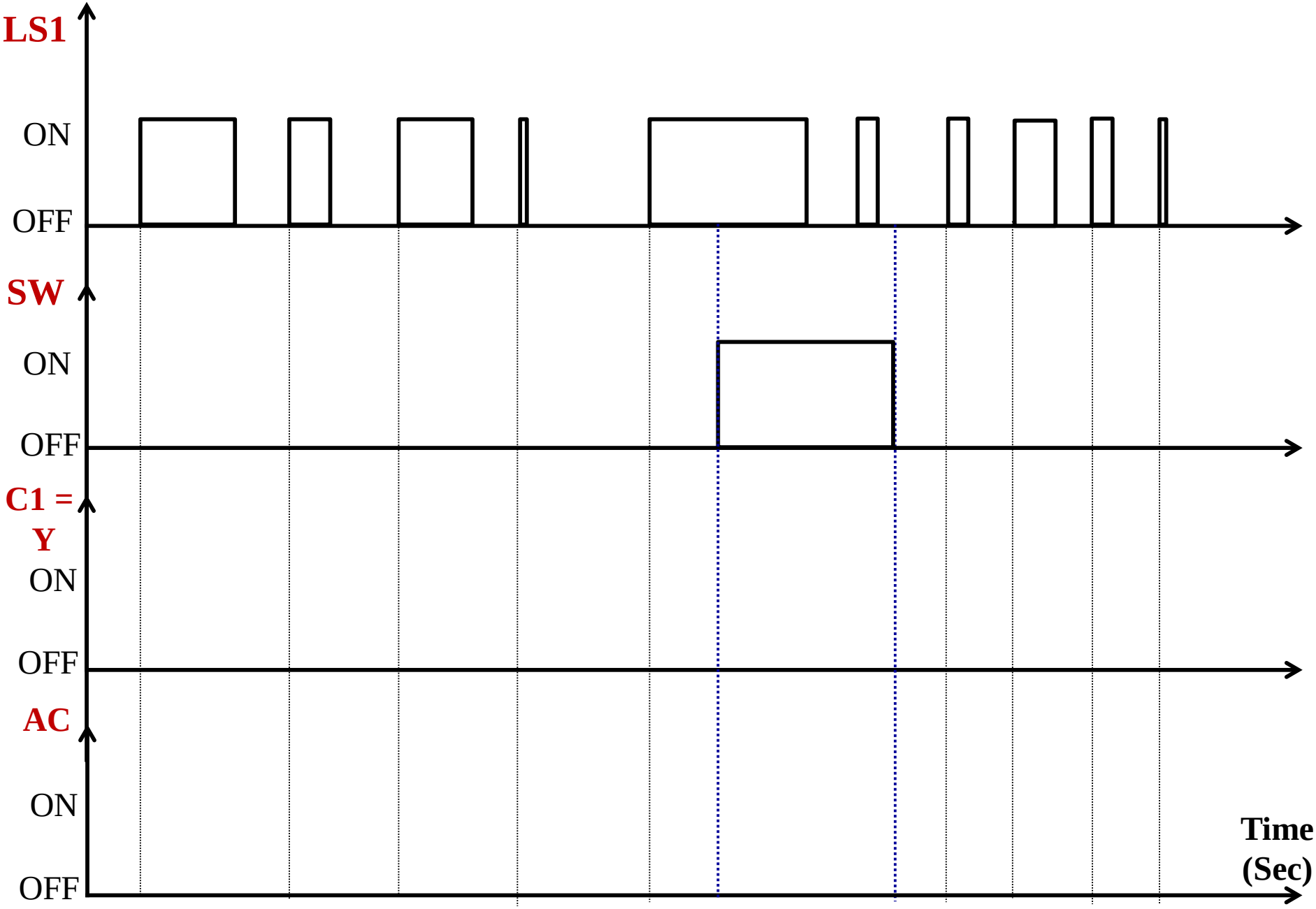


EX1: Up-counter

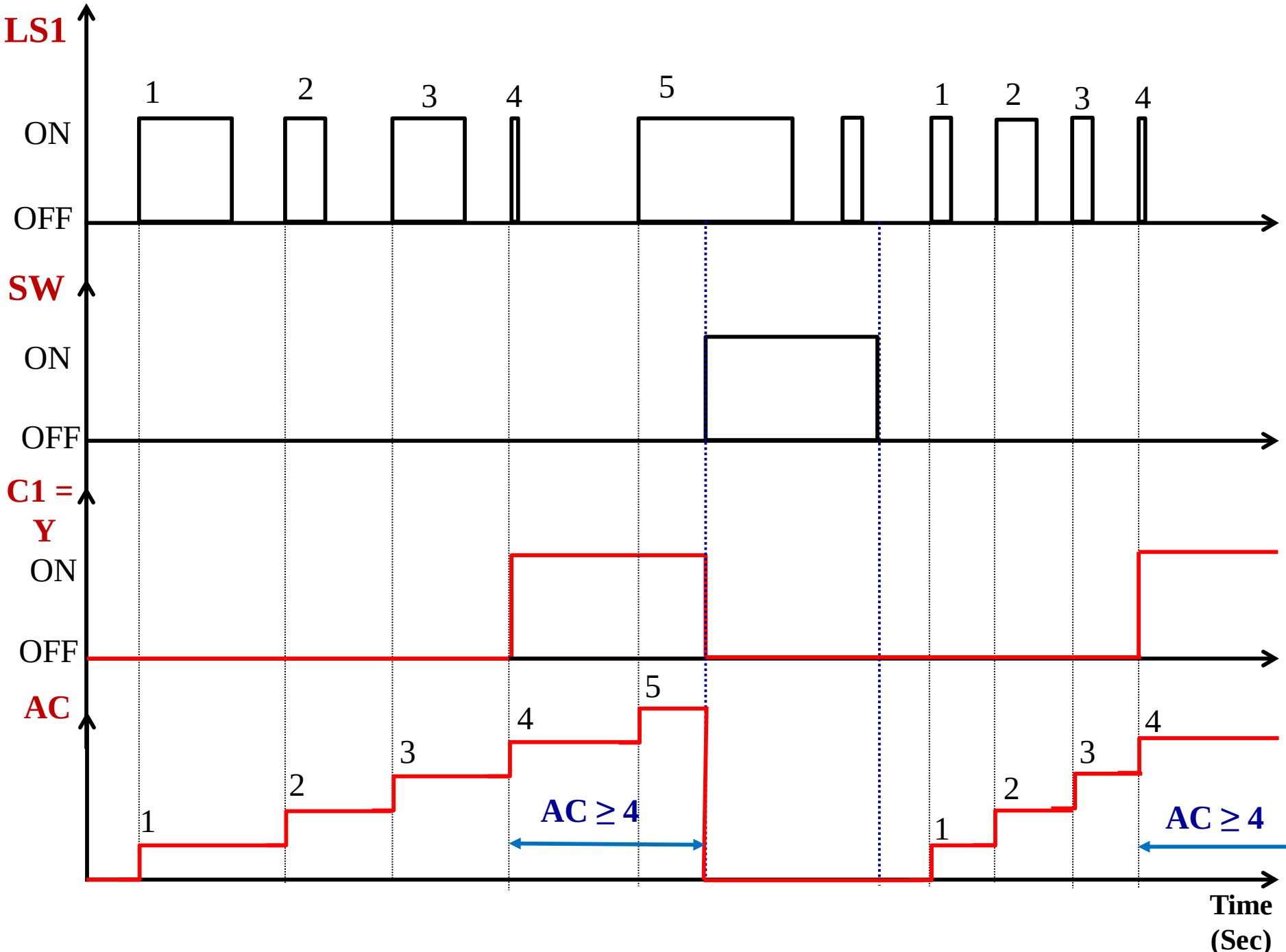
- For the following diagram:



- Using timing diagram, illustrate the states of Y and AC for the following states of LS1 and SW.



Timing Diagram


LS1
ON
OFF
1
2
3
4
5
1
2
3
4
SW
ON
OFF
C1 =
Y
ON
OFF
AC
1
2
3
4
5
AC ≥ 4
1
2
3
4
AC ≥ 4
Time
(Sec)

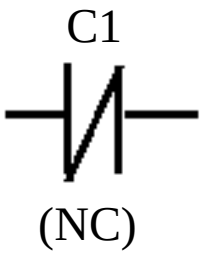
(2) Down-counter (CTD)

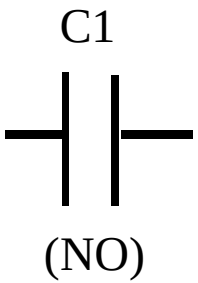
- Down-Counter decreases the accumulated value by 1 at each false-to-true transition occurs.
- AC is initialized by the PR (start counting from PR) and then it decrements at each false-to-true transition.
- The AC value may be less than zero (negative) according to the no. of false-to-true transition.
- CTD is energized and changes the position of its contacts (from normal state to a another state) when AC value equals to zero and still energized even if the AC value is less than zero (CTD is energized while AC $\leq$ 0).

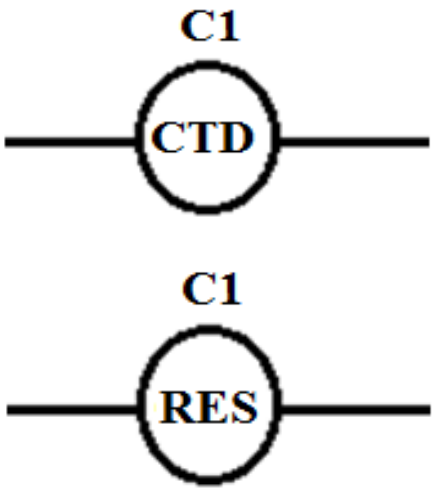
(2) Down-counter (CTD)

- When we reset the CTD by the RES instruction, the AC value is reset to PR and the CTU is de-energized.

- Symbols used in ladder diagram:

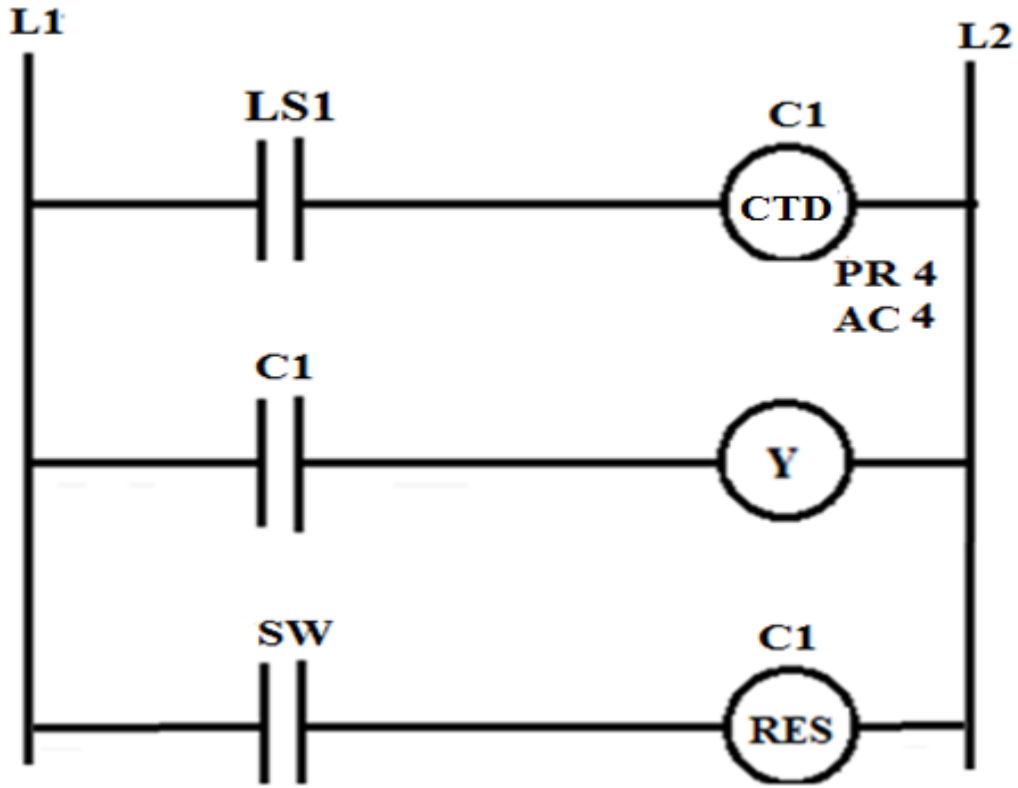




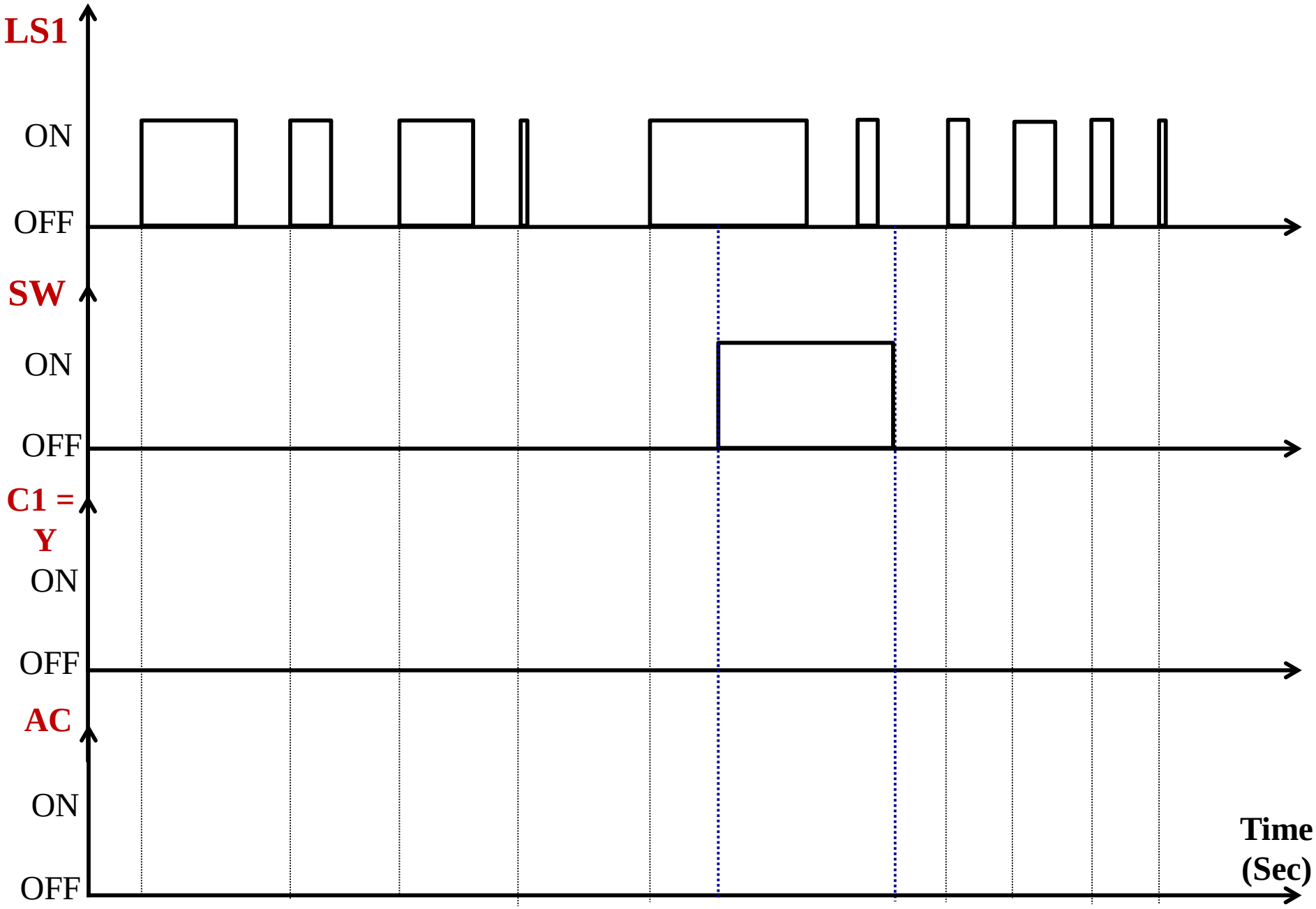


EX2: Down-counter

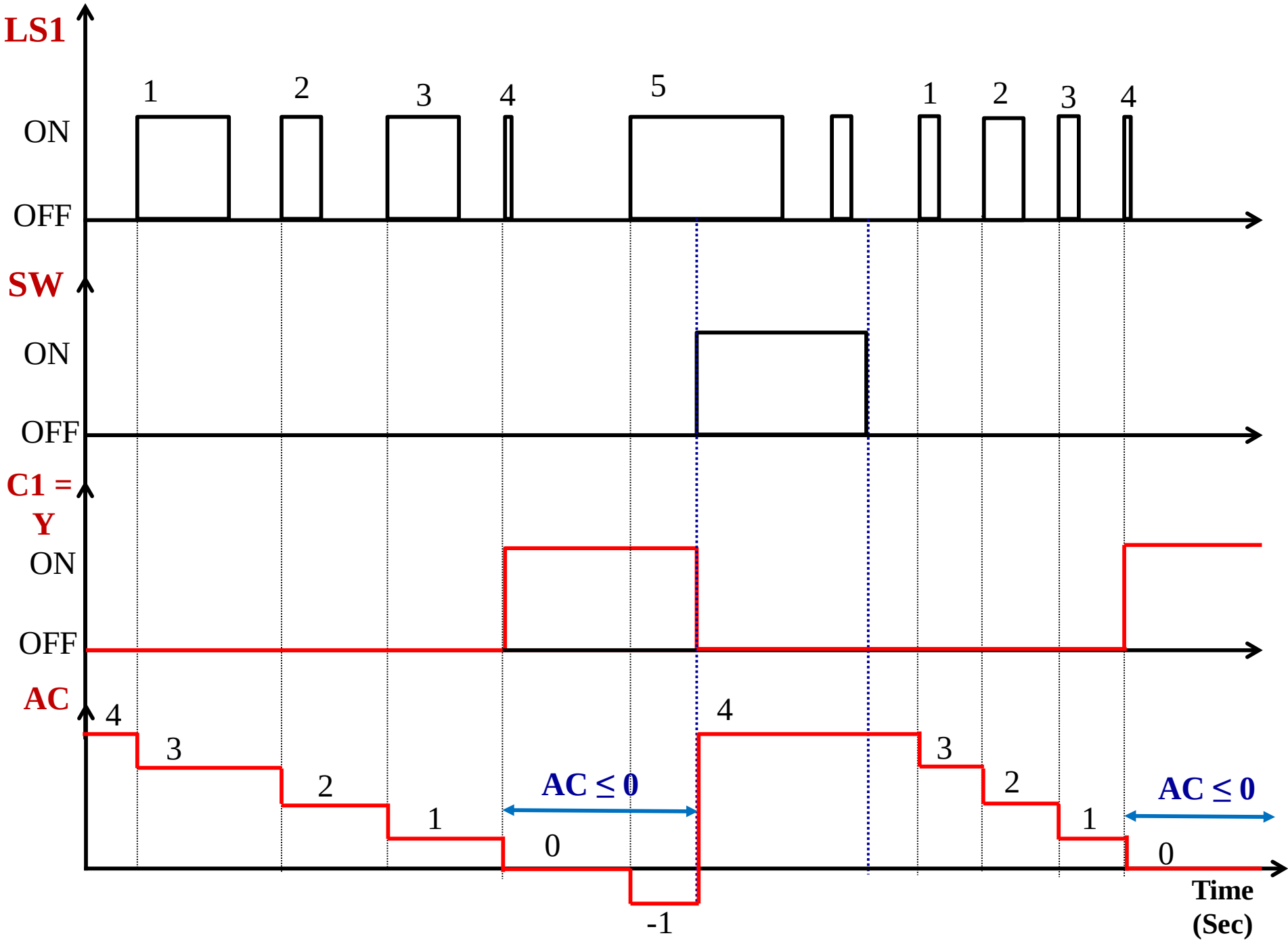
- For the following diagram:



- Using timing diagram, illustrate the states of Y and AC for the following states of LS1 and SW.



Timing Diagram


LS1
ON
OFF
1
2
3
4
5
1
2
3
4
SW
ON
OFF
C1 =
Y
ON
OFF
AC
4
3
2
1
0
-1
4
3
2
1
0
AC ≤ 0
AC ≤ 0
Time
(Sec)

(3) Up-down Counter

- UP-down Counter increases or decreases the accumulated value by 1 at each false-to-true transition occurs.
- AC is initialized by zero (start counting from zero) and then it increments or decrements at each false-to-true transition.
- The AC value may be exceeds the PR value or may be less than zero according to the no. of false-to-true transition.
- UP-down Counter is energized and changes the position of its contacts (from normal state to a another state) when AC value equals the PR value and still energized even if the AC value exceeds the PR value (UP-down Counter is energized while AC $\geq$ PR).

(3) Up-down Counter

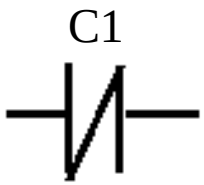
- When we reset the UP-down Counter by the RES instruction, the AC value is reset to zero and the UP-down Counter is de-energized.

- To use the UP-down Counter, three rungs should be used:

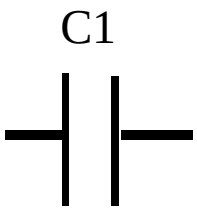
  1) One rung for counting up
  2) One rung for counting down
  3) One rung for resting the counter (to make AC = 0 and de-energized the counter)

(3) Up-down Counter

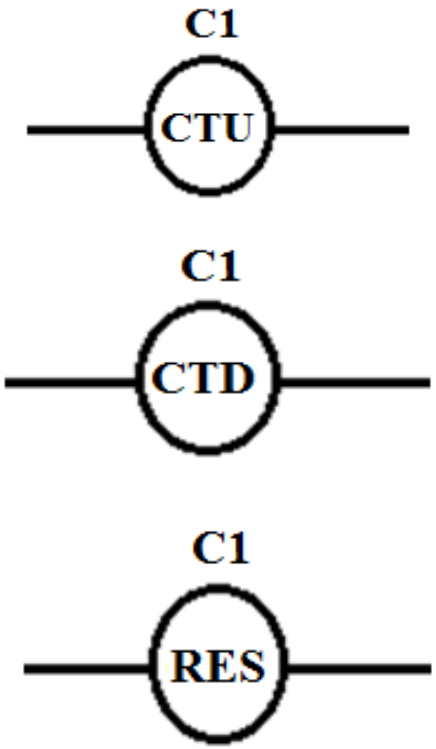
- Symbols used in ladder diagram:



(NC)

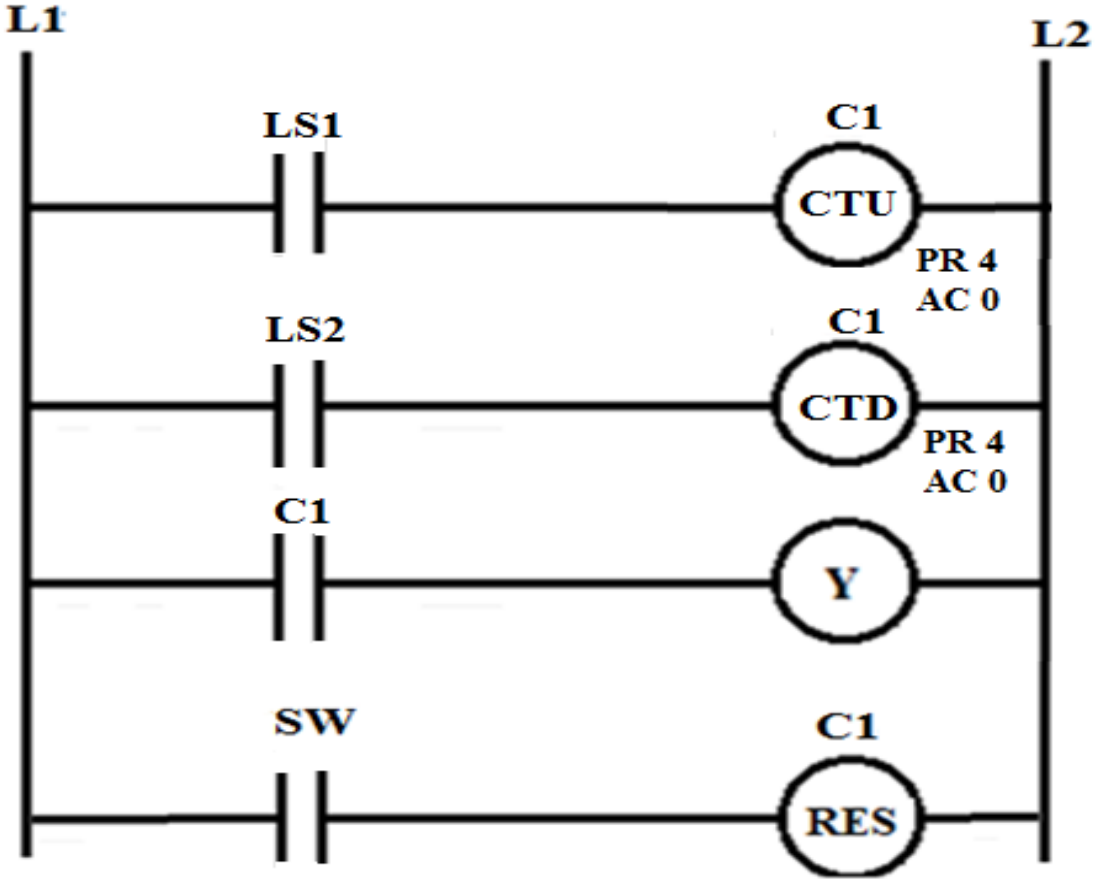


(NO)

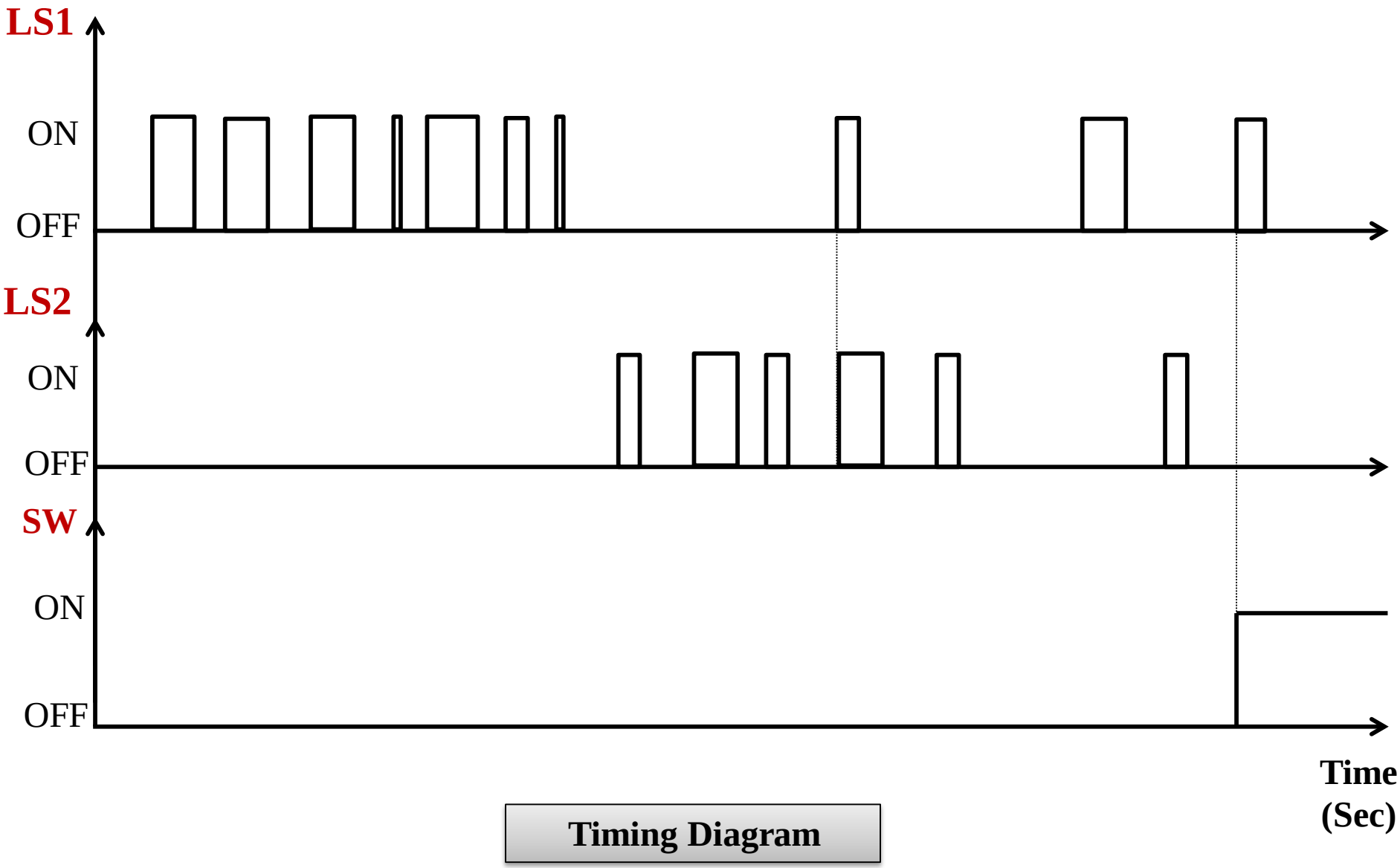


EX3: Up-down Counter

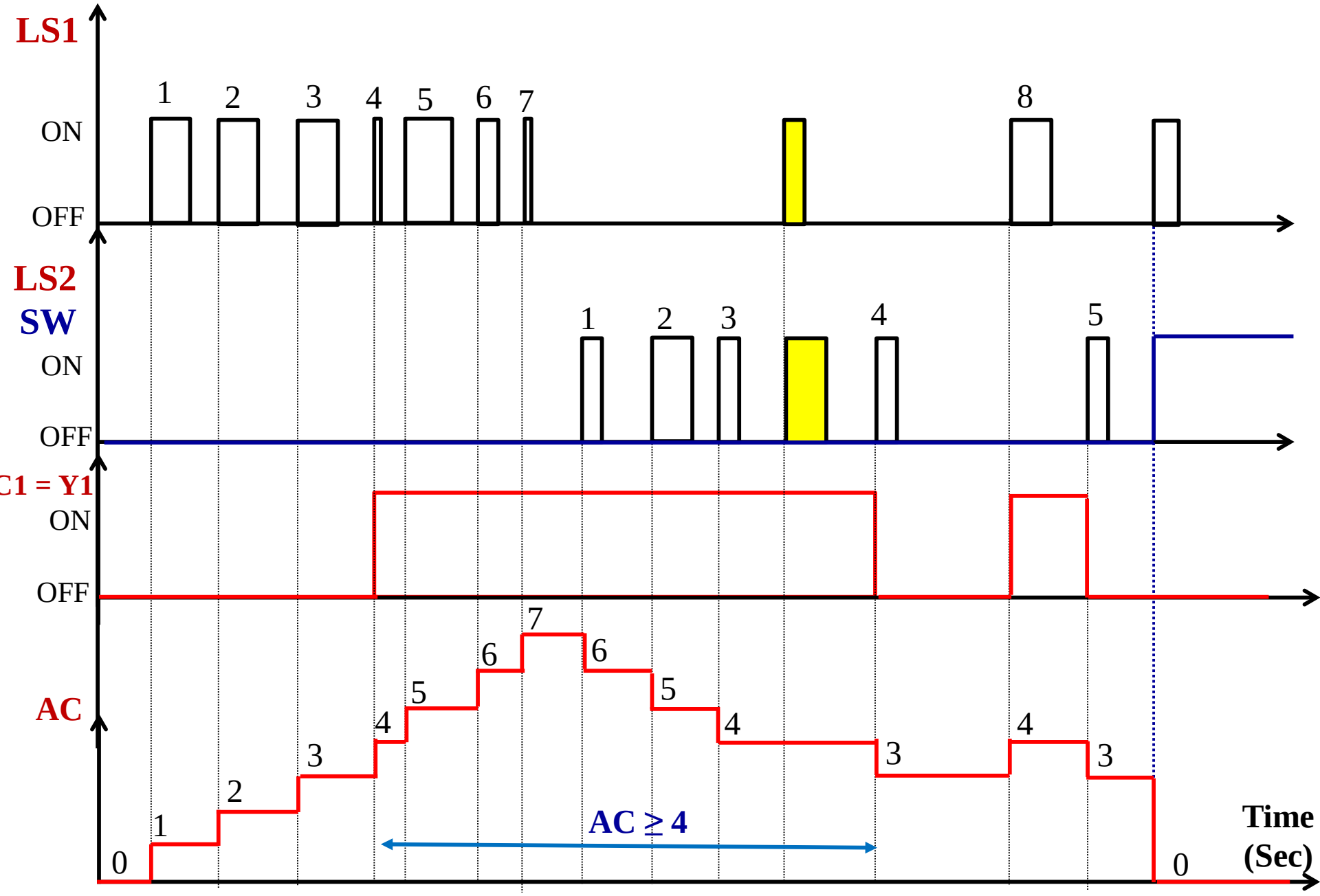
- For the following diagram:



- Using timing diagram, illustrate the states of Y and AC for the following states of LS1, LS1 and SW.



Timing Diagram


LS1
ON
OFF
1
2
3
4
5
6
7
8
LS2
SW
ON
OFF
1
2
3
4
5
C1 = Y1
ON
OFF
AC
0
1
2
3
4
5
6
7
6
5
4
3
4
3
0
AC ≥ 4
Time
(Sec)